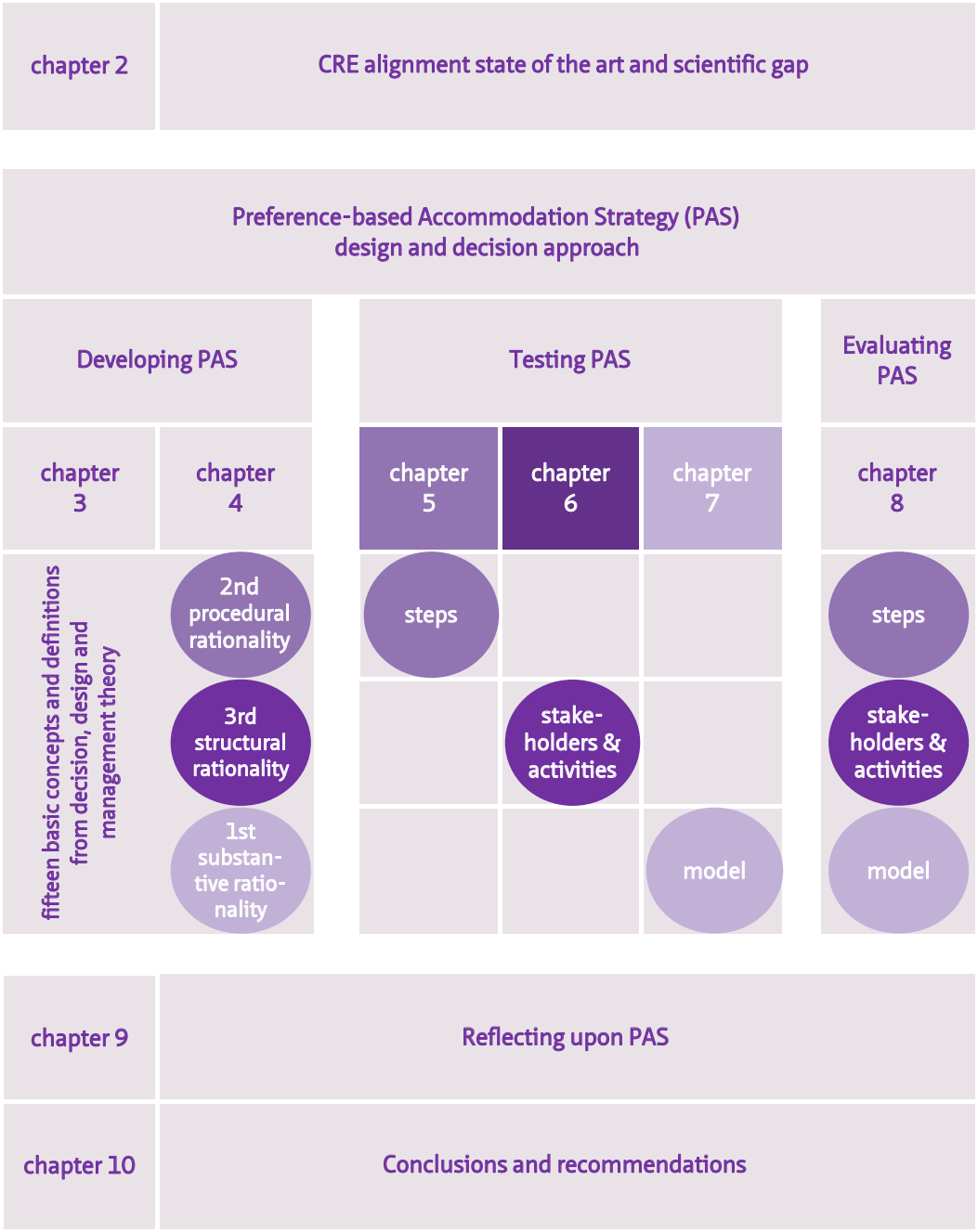
8 PAS evaluation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8 PAS evaluation

In this chapter the evaluation of PAS will be discussed. The use of PAS has been extensively reported in chapters 5 (steps), 6 (stakeholder & activities) and 7 (mathematical model). The use of PAS has been successful, this means that stakeholders are able to use PAS. In this chapter the evaluation of the stakeholders of PAS is discussed. This answers the question if the stakeholders want to use PAS.

Recall, that PAS comprises of steps, stakeholders & activities, and mathematical models. The activities consist of a sequence of interviews and workshops and a simultaneous design and calibration of the mathematical model. The pilots resulted in a final design alternative and a final mathematical model.

The evaluation is given per pilot study and this chapter has the following structure:

- TU Delft pilot for the food facilities in paragraph 8.1;
- TU Delft pilot for lecture halls in paragraph 8.2;
- Oracle's pilot for office locations in paragraph 8.3;
- Pilot comparison and conclusion in paragraph 8.4.

In each of these paragraphs, the four types of measurements that Joldersma and Roelofs (2004) use, will be addressed.

In the first subparagraph the stakeholders' evaluation is discussed. Here, the first three measurements were addressed: (1) experiences with PAS, (2) attractiveness of PAS and (3) participants' observations on effectiveness of PAS. In general, it is not indicated which particular stakeholder gave feedback if their role in the organization was not relevant for the remark. Only in cases where the role and background of the stakeholder was relevant to their remarks, it is indicated which particular stakeholder gave these remarks. In the second subparagraph, the fourth measurement, namely the observers' perceptions of the effectiveness of PAS is reported.

In the text, the frequently mentioned positive aspects and areas of improvement are underlined and will be used in the conclusion and pilot comparison.

8.1 Pilot study 1: TU Delft's food facilities

8.1.1 The stakeholders' evaluation

In this pilot, both workshops were group workshops with all stakeholders. In total six different stakeholders groups were involved, consisting of eleven different persons, with whom in total twenty interviews were held (see appendix H).

Arkesteijn et al. (2017, pp. 258-259)[66] reported the following evaluation for this pilot:

Initial attitude towards PAS and the pilot

In the first interview, apart from giving input for the first four steps of PAS, the participants were asked to give a first evaluation of the procedure. The answers from the interviewees in combination with our observation painted the following picture: most of the stakeholders were open to the procedure and willing to participate. One participant questioned the possibility to include emotions into the model and one of the stakeholders was suspicious of the model and questioned whether it could work as intended.

Experience with PAS

After the first workshop most stakeholders were mainly positive. The item that was mentioned most often in all interviews was the possibility of iteration[67] in the model. Iteration made it possible for them to formulate the decision variables as they intended. Two other traits of the procedure (the group interaction and the transparency of process) were also highly valued. The use of the model and their positive experiences with it generated trust in the model. After the second workshop

66 For the ease of reading, the section numbers of the paper are not used in this paragraph. Furthermore, the first paragraph of the published section 7 is not included here and the last section about the evolving perceptions is added.

67 As reminder, the frequently mentioned positive aspects and areas of improvement are underlined and will be used in the conclusion and pilot comparison.

a result of an overall preference score of 95 was achieved. Stakeholders indicated that they had not expected to reach such a high score. One of them specified that, Therefore, he had not been tempted to use any strategic behavior.

The second workshop confronted us with a problem: the concepts food facility middle and large were unclear. The Facility Management and Real Estate (FMRE) department intended the food facility middle to be a coffee corner, without the traditional hot servings at lunch, while other participants preferred it to include hot servings. It was agreed that the results of the model would only hold under the condition that concept middle would be the latter option.

Attractiveness of PAS

The stakeholders found the experienced interaction, iteration and transparency attractive mainly because they could give and determine their own input. Their main attitude was one of satisfaction. However, they were encouraged to give feedback to improve the approach and/or model. They have been especially critical of the design interface of the model. It was not always easy for them to keep an overview, although the model helped them to do so. It seems that this was caused by several factors for different people. Two participants wanted to understand more of the backend of the model, i.e. how the relationships were defined between the variables. This would help them to define their decision variables and curves better and in the end accept the model and its results. Another participant stated that the model is less attractive because it is not operated by the stakeholders themselves and suggested that this might need more time.

Perception of effectiveness

The procedure has been described as very effective. It does not take much time, is to-the-point and much more result oriented than similar processes. The ... design[68] of the alternatives is seen as a trial-and-error process whereas the effects of the interventions are clear: they function as input to realize an optimal solution. This process deepens the conversation about the alternatives. Another user acknowledges the transparency of the model, the speed of its execution, and especially, the clarity of which demands have or have not been taking into account in the chosen alternative. One participant wondered whether the expected effects could indeed be achieved in practice. (Arkesteijn et al., 2017, pp. 258-259).

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68 In the paper I referred to self-design. In this thesis, it is referred to as design.

It showed during the evaluation that stakeholders besides giving remarks about the perception of the effectiveness also commented on the degree of efficiency of PAS.

Evolving perceptions

Two stakeholders expressed their initial concerns with the method and it is interesting to see how their perceptions have evolved. The stakeholder that doubted whether emotions, i.e. qualitative aspects, could be integrated into the method was maybe even the most enthusiastic stakeholder at the end. The pilot study fully convinced him that his doubts were unfounded and it was indeed possible to give quantitative measures to qualitative aspects. The stakeholder that indicated that the approach could be overly transparent and too complex, indicated he was pleased that the approach led to such an optimal solution (overall preference score of 95). He was surprised, though, with the low overall preference score for the current facilities (43). He also noted that scientists as stakeholder group should have been involved, even though the employees were represented by the works council. However, this stakeholder still expressed concerns about the use of the model, because he assumed it is not always possible to come to an agreement and therefore, wonders whether a check will be made of the end result. Although stakeholders indicated that assigning preference scores is not an easy task initially, in the end they were able to do so because of the iteration between the alternatives they designed, and the insight they were given in the effects of their decision variables.

8.1.2 The observers' evaluation

The facilitator and system engineers' perception of the effectiveness was that the approach has been effective. The stakeholders in the pilot succeeded in designing an alternative real estate portfolio with a higher overall preference score. They have reached a score of 95, which we never expected to be possible at the start of the project. This was possible because in this pilot no or not many opposite requirements have been set .

The facilitator and system engineers stated that the effectiveness of the approach is substantial, nevertheless the approach can be fine-tuned. They observed four types of improvements. Firstly, that the amount of and content in the design interfaces of the mathematical model can be enhanced. The facilitator and the systems engineers supported the stakeholders to read the interfaces and find the interventions with the most effect. After the initial help, most stakeholders were able to suggest interventions independently. Maybe a different interface could be of help here.

Secondly, the nature of the approach should be explained more clearly at the start of the process. During the pilot study some of the stakeholders, on some occasions, stated that PAS was objective and/or the called the nature of the approach rational. Their statements had a positive connotation as opposed to when some people spoke about something being 'subjective'. The 'objective' is to be strived for, while for some the 'subjective' needed to be avoided. The PAS, especially the mathematical model, is based on logical calculations. This gave the stakeholders the impression that this approach was objective and rational. PAS is subjective by definition, since all decision variables, their curves, and weights are linked to a specific stakeholder (i.e. subject). Therefore, 'objective' was interpreted as actually meaning more 'transparent'. During the last interview, it became clear that most stakeholders understood this issue, however, it might be beneficial to find a way to explain this more clearly at the start of the process.

Thirdly, at the start of the project, the FMRE department expected that some stakeholders would set decision variables that would lead to a completely different solution. They expected to have three food facilities *large* on campus and hardly any food facilities of the concept *middle*. However, none of the stakeholders set a decision variable, for instance the possibility to have random spontaneous encounters between members of the whole organization, which could have resulted in less restaurants , mainly of the concept *large*.

Fourthly, next to the pilot study, the FMRE department ran a project where a consultant formulated a vision for the future of the food facilities. However, FMRE indicated that it was not possible to involve this consultant as stakeholder in the pilot, so that he could translate this vision into decision variables, curves and weights. The FMRE department indicated that they will integrate the results of this pilot and the study of the consultant in the future. In order for PAS to be as effective as possible, it is important to involve all relevant stakeholders to reach the best possible solution. However, not involving this consultant may have influenced the validity of the end result for this particular problem, but it did not interfere in testing the effectiveness of PAS itself.

8.2 Pilot study 2: TU Delft's lecture halls

In this pilot, the first workshop was held individually and the second workshop was with all stakeholders combined. For this pilot in total six different stakeholders groups were involved, consisting of twelve persons, who participated in six workshops, and with whom twenty-three interviews were held (see appendix H). It should be noted that three specific persons were involved both in the first and second pilot. These were the Executive Board as subject owner, the FMRE department and the student council. The Executive Board indicated boundary conditions only, and therefore, was interviewed twice, at the start and the end of the process. This means the Executive Board was not involved in the workshops and intermediate interviews. Both the student council and one of the employees of FMRE indicated that they were able to have a quick start due to previous experience, they were also able to compare the two (slightly) different approaches and problems.

8.2.1 The stakeholders' evaluation

Initial attitude towards PAS and the pilot

Initially, only two stakeholders reacted to this question in the first interview. The reason for this might be that the pilot was more complex and therefore, less time remained for the evaluation. At the end of the first individual workshop most stakeholders gave their first impression and called the program: magnificent and very interesting. One of the 'repeating' stakeholders expected it to be difficult to link the preference scores to concrete characteristics of the lecture halls. However, although it is difficult, this stakeholder also valued especially this aspect because it makes stakeholders work towards an end result.

Experience with PAS

The interviews and workshops are generally experienced very positively by the participants. All the participants have indicated that the workshop helped them to gain a deeper insight into the problem, their own decision variables, or those of others. The student council, for instance, understood what teachers wanted and why. The teachers commented that it was very worthwhile to involve the different stakeholders and to understand their needs. Another stakeholder commented that the decision variables of other stakeholders were surprising, and that they gained

more insight in some of the conflicting decision variables. One stakeholder even indicates that using curves to express their requirements in numbers is a huge advantage because it enables the stakeholders to be confronted with the effects of these requirements. Most stakeholders indicated they valued that during the workshop they saw what the effect of their choices was.

The involvement of more stakeholders gave one of the stakeholders the reassurance that 'all relevant decision variables' are taken into account. For example, the stakeholders also realized that there is uncertainty about how education will evolve, and what that means for the necessary facilities. One of the stakeholders therefore, mentioned that next to the current stakeholders it would have been worthwhile to involve another stakeholder with more specific knowledge on the 'future of education'.

The stakeholders value the use of tangible decision variables and indicated that "without the model such a process is less concrete". It helped them to understand the question behind the question. One of the stakeholders was pleased with the pilot because "he was forced to think in what he refers to as 'key performance indicators' instead of ideas". Although this also has led to some uncertainty, especially this translation of ideas into curves made the matter more concrete and prevented him to stay at the level of future images.

The stakeholders were especially positive about the second group workshop; bringing people together, searching together for a good solution, the interaction with each other and the model were all aspects that were rated positively. Some participants also recognized the importance of iteration in the process. The first individual workshop in general was rated less positively because they either did not understand the goal of the workshop or missed the discussion with other stakeholders, although, some participants recognized that they had more time to focus on their own decision variables and understanding the model.

In this stage of the pilot, only one stakeholder is critical of the PAS, he has the impression that the model is too theoretical [69] and the PAS does not reflect reality. He gives an example to substantiate this. For instance, he sees alternative solutions for the problem of recording lectures. According to him, this can also be done with a mobile unit. Although this is technically correct, the decision variable to record lectures was not his own decision variable. This means, that he had no say about

69 This aspect is not taken into account into conclusion because this stakeholder at the end of the process favored the approach.

the decision variable of another stakeholder. The stakeholder who defined this specific decision variable, determined that the mobile units did not suffice. Therefore, based on these examples, it could not be concluded that the approach does not reflect reality.

Attractiveness of PAS

The attractiveness of the method is rated highly by the participants. Stakeholders use different positive words to describe the approach; useful, attractive, visual, interesting, informative and teachable . The way of presenting the PAS is experienced as positive. Similar answers were given as in the former section but some will be elaborated upon.

They found the process of interviews and workshops[70] helpful – the interviews were a more attractive way to think about what you want than, for example, questionnaires, and the workshops were attractive when multiple participants are brought together to discuss the problem. Another attractive aspect is the use of curves. The participants described determining curves as easy, and one participant remarked that the curves result in fewer emotions in the discussion and more focus on the collective interest. What they generally found difficult, is to assign preference scores; they had to estimate their preference when a certain value is achieved. That is why the *iteration* with the possibility of adjusting decision variables is so important. Designing interventions was perceived to be more difficult (Arkesteijn et al, 2017).

"Making curves is easy and the possibility to adjust them and make them more realistic after having the workshop makes the method so strong".

The attractiveness of the approach is that by bringing stakeholders together in the second workshop, a common frame of reference is made. This potentially avoids unnecessary discussion and makes different stakeholders less prone to only hold on to their own decision variables. Other than that, both the FMRE and the Education and Student (E&S) Affairs department stressed the positive interaction in the joint search towards a solution.

The interface is described as easy to use, visual and simple. One of the 'repeating' stakeholders complimented us on the interface "it looks good and even easier (than the first pilot)". If the interface is actually easier, the stakeholder can only assess if

70 The interviews are linked in conclusions to insight in decision variables and the workshops to group interaction.

he would operate the model himself. One stakeholders missed the creative part in which the stakeholders can search solutions that are not part of the model.

Perception of effectiveness

When asked about their perception of the method's effectiveness, most participants responded very positively. Some of them thought that it helps to reach an agreement[71] on an end result and that they have understood quicker why certain choices are made. Some stakeholders explicitly indicated that the approach will support them to make a better plan. One of the stakeholders indicates that he "believes a good solution can be reached with the model and expects that this approach will help to make better substantiated (investment) decisions". And especially valued was the cumulative insight in the effects, although not all stakeholders were able to easily see this *'cumulative' effect*. Two of them found it difficult to assess the effectiveness of the model.

Suggestions to improve the perceived effectiveness

After the last workshop the stakeholders accepted the results of the design process. In the last interviews, some of the stakeholders took the opportunity to change their input (decision variables, curves and/or weights). By doing so they fine-tuned their input. The results of the pilot study were taken into account by FMRE and E&S Affairs in the development of the lecture halls, but not implemented as such. If the results were to be implemented, another iteration round could be useful.

The stakeholders gave suggestions how to make the model and its input more realistic. Firstly, they suggested to involve more stakeholders and also different types of stakeholders (with more knowledge of the future of education). Secondly, some suggested to add more types of lecture halls (next to the large lecture halls also the medium sized ones). Thirdly, it would benefit the model to have better cost estimates. Fourthly, the teachers' representative is in his regular work very familiar with computer algorithms and therefore, suggested to use an algorithm[72] that could replace the design to find the optimal solution. Fifthly, adding a way to see the sensitivity of the parameters that are used; could improve the approach as well. Sixthly, one of the stakeholders indicated that the results would improve

71 This aspect is linked to result oriented in the conclusions.

72 Whereas an algorithm can have the meaning of a step by step approach (see chapter 2), here the stakeholder refers to an algorithm performed by a computer.

if the stakeholders were given more time for the process. Lastly, two stakeholders indicated that they would like to be able to use the model themselves during the process. To increase the effectiveness of PAS, the stakeholders gave the abovementioned seven particular suggestions.

Perceived effectiveness in comparison to other approaches

During the evaluations some stakeholders spontaneously compared PAS with other approaches, although the study was not set up to compare PAS systematically to other approaches. Below, the different comparisons that were made are elaborated upon. When looking at the time spent and the results of the process, most participants responded that the process is certainly efficient compared to others, while some felt it took more time than similar processes. One of them compared PAS (1,5 day in total) to an approach in which he was involved in an one-hour interview. In that interview he was asked to give his vision and ideas but did not need to formulate concrete decision variables and make design alternatives. Whether or not the extra time spent is worth it depends on the outcome of the last workshop.

"The approach is quick. Only after four months [duration] a result is achieved with many stakeholders. Compared to other processes this is very effective. The process is quicker, more concrete and more insightful".

One of the stakeholders states that "PAS is a better way to work together than the current FMRE approaches". Another stakeholder compared PAS to meetings, and indicated that it is more difficult to understand other stakeholders' decision variables in a meeting. In that approach, communication is often between the FMRE department and each of the stakeholders individually. The fact that in PAS the stakeholders meet as group, was valued more. One stakeholder was curious to know how the PAS compared to another study about lecture halls that took place, in the same time period (Kraak & Netten, 2013). Initially, he saw the research projects almost as opposites. Whereas, the latter research was qualitative the PAS approach was rather quantitative. However, later in the process this stakeholder indicated that his evaluation changed in two ways: in PAS he valued the connection between the quantitative and qualitative, and he stated – as has been shown in the experiences - how important the translation into concrete decision variables was. All stakeholders that compared the PAS to another approach, favor PAS.

At the end of the pilot, the results were presented to a new member of the Executive Board. This board member was not involved at the start of the research but was responsible for E&S Affairs for many years. Therefore, she was familiar with the subject matter and explained that the problem of lecture halls is a longstanding issue

and that many of the former research projects missed something. A former research project focused on the Directors of Educations' vision on future developments which resulted in qualitative pronunciations and vision but lacked concrete interventions. Another research project focused on the teachers' vision on facilities the lecture halls needed to have, resulted in concrete solutions but lacked the connection to the strategic level. PAS is "exactly what is needed, because it links *concrete interventions to strategic objectives*".

Role and use of the facilitator and system engineer

The FMRE department acknowledged the role of the facilitator and the system engineer as positive. They valued their guidance during the use of the model, while staying neutral. Especially for this reason FMRE department indicated that they prefer to make use of a facilitator, instead of taking this role themselves. Even though, the model looks easy to use from the stakeholders' point of view, the backend of the model is complicated. Therefore, FMRE also indicated that a system engineer is needed to build the model.

Evolving perceptions

Two stakeholders were more critical at the start of the pilot, as we have seen above. For both a reflection is made how their perceptions have evolved over time.

The stakeholder that stated at first that the model was too theoretical and abstract, indicated in a later stage that it is a good step forward that the problem can be modeled. The model gives insight in the choice you make and what is really important. The involvement of different types of stakeholders is valuable. In the last interview he even said that he thought this [PAS] is the correct route for teachers'. The different way of approaching a problem has effect.

One of the involved Executive Board members who wondered whether this approach could be too transparent, was positive about the results that have been achieved in both the pilot studies. For the constraints he has given, he is interested in understanding the 'jumping point' in the model. The jumping point indicates when an alternative is feasible or not. It is understandable that this stakeholder is interested in this issue, because his constraints 'student satisfaction' and teacher satisfaction' are dependent on preference scores of these stakeholders. The subject owner was involved in the pilot only at the beginning and the end. Maybe it would have been better to involve the subject owner during the process as well, because this would have given him the ability to iterate his constraints. He would have learned about the jumping process during PAS. The stakeholder also suggests to use a hierarchy

in the interventions. Whereas this subject owner was positive about the results, this does not mean that he is convinced that the process should have this level of transparency. This means, that the evaluation of Executive Board members was not unambiguous. While this subject owner still is reserved about the desired level of transparency the new member of the Executive Board , on the other hand fully supports this way of working.

8.2.2 The observers' evaluation

The facilitator and system engineer's perception of the effectiveness of the method is that it is very effective, but that there is also room for improvement. When viewing the end result as a measure of effectiveness, the outcome shows that the participants succeeded in finding a combination of real estate interventions and scheduling interventions that improved the overall preference score from 58 to 69 (out of 100). Furthermore, because the model addressed both problems, it made participants think about trade-offs they would otherwise not consider. For example, the teacher present in the workshop asked himself: "would I prefer a lecture hall during day time more than a lecture hall in the evening that has all the amenities I need for my lecture?".

When viewing the effectiveness of the method from the stakeholders' point of view, the method is highly effective. The problem of designing an optimal portfolio of lecture halls is a complex problem that involves many stakeholders and, as we found in the interviews, is also entangled with the problem of designing an optimal schedule. The method gives the stakeholders the opportunity to present their preferences in an efficient way and to design solutions based on all stakeholders' preferences in a model. The traditional process is probably a series of joint meetings in which stakeholders reveal their preferences partially and in different ways. Then alternatives are presented that each stakeholder evaluates based on their own perception of how well that alternative meets their preferences. This process requires more meetings, more work on the part of the involved stakeholders and gives less insight to a stakeholder if the chosen solution actually meets their preferences.

The PAS process differs in many aspects from the processes these stakeholders were used to. Initially, most stakeholders are reserved in assigning their preferences in this way: they are concerned that if they make their preferences explicit that it will also mean that they are definitively captured. Once it is clear to them that they may adjust them at any point, this concern is removed. Furthermore, they are concerned that establishing their preferences might 'objectify' the process. Often in

the workshops it becomes more clear for stakeholders why it is so important that they have made their preferences explicit due to the discussion that ensues about trade-offs in the model and about their own preferences. A remark heard often is that the process has therefore become more ‘objective’ which we interpret as actually meaning more ‘transparent’.

When viewing the effectiveness of the method from the system engineer’s point of view the method is less effective than in the first case. The addition of a scheduling component to the model significantly increased the build time for the system engineer. Furthermore, the scheduling component has limitations to the scale of the solution that it can compute; hence, only a small scale simulation can be done for a university schedule and the schedule can only be optimized on one decision variable. This decreases the effectiveness of PAS which is specifically designed as a multi-decision variables method in order to design real-life real estate portfolios. It makes the model more complex and therefore, harder to understand for the stakeholders when compared to the first PAS pilot. In the workshop the model required more assistance from the facilitators: especially with regard to the scheduling interventions the facilitator was operating the model whilst discussing the effect of possible interventions with the participants, rather than letting the participants operate the model. Selecting real estate interventions could be done by the participants themselves.

Finally, in this particular case it was decided to do the first workshop individually per stakeholder in order to allow them to become more acquainted with the model. Although this did have an added value, it did reduce the opportunity to design alternatives as a group and learn from each other. With an extra joint workshop more time could have been spent on designing alternatives which would have led to a higher overall preference score. The maximum score achieved prior to the workshop by the system engineer was 79. A higher score was nearly impossible to achieve due to the trade-offs present in the model: optimizing on decision variables such as frequency rate and occupancy rate would worsen the result on the % of lectures in the own faculty, walking distance and amount of changes between buildings.

8.3 Pilot study 3: Oracle's office locations

In this paragraph, the evaluation of third pilot study is presented. De Visser (2016) followed the same protocol for data collection in the interviews. However, different questions were used, because of the different nature of this pilot. De Visser not only used the design of alternatives by the stakeholders (step 5a) in the pilot but also an optimization tool (step 5b) as has been explained in paragraph 4.5 and chapter 7.3. When evaluating PAS including the use of this optimization tool, it could be different for the stakeholders because this tool belongs to the hard systems approach. Therefore, De Visser used a checklist based on (Riedel et al., 2010) to evaluate a decision support system and its development process. The checklists' elements are more detailed than the ones of Joldersma and Roelofs (2004), but De Visser made links between both as shown in Table 8.1.

TABLE 8.1 Checklist for evaluating DSSs and their development process Note adapted from De Visser, 2016, p. 89

Evaluation category (Joldersma & Roelofs, 2004)	Characteristics	Resulting effect (Riedel et al, 2011)
Experience	Stakeholder interaction (Van Loon et al., 2008)	system acceptance
	Iterative system development (Van Loon et al., 2008)	system acceptance
	Familiarize with backside of the system (Riedel et al., 2011)	trust in system
Attractiveness	Perceived control (Riedel et al., 2011)	system acceptance
	Complexity (Riedel et al., 2011)	system acceptance
	Calibrated variables (Van Loon et al., 2008)	trust in system
	Perceived usefulness (Riedel et al., 2011)	system acceptance
	Purpose (Riedel et al., 2011)	trust in system
	Perceived ease of use (Riedel et al., 2011)	system acceptance
	Justification of outcome (Riedel et al., 2011)	trust in system
Effectiveness	Clear system goal (Van Loon et al., 2008)	system acceptance
	Performance reliability (Riedel et al., 2011)	trust in system
	Justification of outcome (Riedel et al., 2011)	trust in system
	Participation & involvement of stakeholders (Riedel et al., 2011); user consultation (Van Loon et al., 2008)	system acceptance

This means that he uses different vocabulary in the evaluation as has been used in the first two pilots. At the end of this paragraph the pilot's evaluation is summarized according to the evaluation aspects; experience with the approach, attractiveness of

the approach and its perceived effectiveness. In total two stakeholder groups were involved in this pilot consisting of three different persons. De Visser conducted in total two workshops and four interviews.

In this paragraph, the characteristics are underlined to guide to reader through the text instead of the positive aspects and areas of improvement as has been done in the two previous paragraphs.

8.3.1 The stakeholders' evaluation

De Visser (2016, p. 88) concluded that "In general, the stakeholders evaluated the PAS as very positively. They even indicated that the model is a great improvement over their current process and they are looking forward to be able to implement the tool in their actual decision making process".

De Visser (2016, pp. 89-92)[73] reported the stakeholder evaluation as follows:

The stakeholders indicated that they felt very much *involved* in the development of the model by thinking about the right selection of decision variables and establishing preference curves. This made them accept the model and its outcome. They also think that the use of preference curves helped to develop their preferences and it better reflects the actual preferences. One of the [advanced planning] team representatives indicated that

'She feels inclined to put more thought in fewer decision variables, which means a choice for quality over quantity.'

Both representatives of the [advanced planning] team indicated however, that due to the complexity of the PAS principles, i.e. thinking in terms of decision variables, preference curves and weights, the real challenge is to get the right people from the [line of business] involved that are able to understand the principles and have the time to provide the right information. A manual, explaining the principles of each step of the PAS, might be helpful to improve the understanding. Stakeholders experienced the *interaction* and combined effort in the process of establishing preference curves

73 The long citations ar displayed in purple. Besides this, De Visser marked certain words **bold**, in this thesis these words are marked italic. Textual alterations are: the word stakeholders is used instead of users and the abbreviations for organizational units have not been used as in the original text.

and decision variables weights as extremely helpful. This also helped to develop their preferences.

The stakeholders think that the current process contains sufficient *iterations*. Moreover, they found the iterative model development process and the workshops extremely helpful to understand the principles of the PAS and the model, which increased their acceptance.

As the representative of [line of business] 1 indicated,

'This [the PAS principles and model building process] gives a sense of analysis robustness to the user who is customizing the variables that will contribute to the final results.'

The effect of the current process is that the stakeholders have a positive *perception of their control* over the model, as they see the effects of their input. This partly resulted from their perception of involvement and the fact that a model has been developed with the right level of complexity.

The stakeholders have gained sufficient understanding of the *backside of the model*, during the workshops and through the explanation of the systems engineer, to trust the model and its outcomes. It made them understand how the model uses the physical location data to arrive at the preference rating. However, one of the stakeholders would be interested to develop more knowledge of the actual operations in Matlab.

In every model building interview and workshop, the *goal of the model* was recapitulated, in order to refresh this. According to the stakeholders' answers, the goal was clear at all times.

All stakeholders indicated that the final *model complexity* reflects the actual decision making process very well. Especially the improvements made in the model after the first workshop, by adding additional design constraints, helped to establish the right complexity level. This increases the users' model acceptance. The representative of [the line of business] 1 recognized that

'the good thing is that the model is flexible and just setting to 0% [weight red.] some of the variables, the complexity can be reduced if needed.'

Both representatives of the [advanced planning] team indicated that the *calibration of variables* at the end of the pilot study was sufficient. They both positively evaluated the flexibility in the procedure, which enabled adaptation of their input. One of them indicated that it was good to see the refinement of the model in the second workshop. Both aspects increased trust in the model.

The stakeholders' *perception of the usefulness* of the model is very positive as well. In general, all of them see it as a very useful tool that they would like to use in the actual location decision making process. They were specifically positive about the use of the preference curves to interpret the data, which results in a more refined interpretation and better representation of actual preferences than was possible in their original process. Also the stakeholders indicate that the optimization with the brute force function adds up to their positive perception of the usefulness. However, one of the representatives wondered whether there are graphical representations of the outcomes possible that enable presenting the output to executives more easily. The positively perceived usefulness is directly connected to acceptance of the model, according to one of them.

The stakeholders indicated multiple times that they trust the model. The fact that the model in the pilot study was custom made for the *purpose* it was used for, might have had a positive influence.

In terms of *ease of use* of the model, the representatives of the [advanced planning] team are divided to some extent. Both provided very positive feedback on the ease of use of the design interface, the feedback it provided on the locations selected and the constraints. Also designing and evaluating portfolio alternatives was easy enough. Together this increased their system acceptance. However, one representative indicated that in practice the ease of use would also depend on the amount and complexity of the back-end modelling that is required.

According to the stakeholders from the [advanced planning] team, the model *performs as expected* or even better. The expectations were mostly confirmed during the workshops with the model. Also the model outcomes are in line with the expectations that are based on the understanding of the model. Especially the fact that there is a large overlap in the top-15 of the location ranking from the PAS, with that from the original study increases the trust in the model.

The *justification of the outcome* in the design interface is evaluated as sufficient by the stakeholders. One of the [advanced planning] team representatives indicated that it would also help to increase the trust in the model from this perspective, when she would have an improved understanding of the model's back-end.

Experience, attractiveness and effectiveness

As each of the characteristics of the checklist is connected to one of the evaluation categories of Joldersma and Roelofs (2004), it can be deducted from the positive evaluations regarding these elements that the stakeholders had a positive experience with […] PAS in this pilot study. Also they clearly find the resulting model attractive, as they indicate that it is very useful and easy to use. The stakeholders indicate that it better represents the preferences than the current process, it is flexible and works efficient in terms of rating physical location data and also designing and comparing alternatives is easy. Also the optimization with the brute force function is evaluated positively. Moreover, they said that they would like to use it in their daily practice.

The effectiveness of the tool as perceived by the stakeholders is good. As indicated by the [line of business] 1 representative,

'it is an excellent data driven tool to support the decision making process.'

Acceptance and trust

From the checklist at the beginning of this paragraph, it follows that each of the evaluated characteristics result in either acceptance of the system or trust in the system and its outcome. The results presented previously show that the stakeholders repeatedly confirmed their acceptance of the model and trust in the model.

A specific element that induces the user's acceptance of the model is the fact that they felt involved in the iterative development process and gained understanding of the principles of the PAS and the model. Also the fact that the model is perceived as very useful in practice and very well reflects the actual decision making process and the user's preferences, adds up to the acceptance level. This is summarized as follows by the representative of [the line of business] 1:

'The model is flexible and gives the user levers for customizing it in line with the requirements and the reality of the data points [i.e. decision variables].'

According to the evaluation results, an important role in trusting the model is played by the knowledge of the PAS principles and the backside of the model operations. Also the performance that exceeds the expectations plays a role here, especially the overlap in ranking from the PAS with the original study is deemed important.

In the final evaluation interviews, both representatives of the [advanced planning] team were asked whether or not they accepted the optimum portfolio alternative

they designed as final outcome of the … design process and if they would use the current model in their daily practice.

Both members/ participants of the [advanced planning] team were very confident in their positive answer. Also they indicated that it would require only minor iterations on the data to actually implement the model's outcomes. Also one of them indicates that she would trust the optimum portfolio alternative found by the optimization algorithm, because she understands the model. Still a question is, however, whether or not it would be possible for her to replicate the current model code for a similar project. The evaluation of the outcomes of the brute force function, instead of the algorithm, was quite positive. Both stakeholders accepted the number 1 alternative as the best outcome of the pilot study. However, one of them indicated that she feels a little more comfortable with the number 2, since Oracle has already a small office in location 26, which is incorporated in that alternative instead of location 27. However, this does not affect the assessment of the brute force function since there is only an insignificant difference in preference between both alternatives. The other user indicated that she accepts it as the best theoretical outcome. She notes, however, that in reality this might not be the best solution since there is a current portfolio and there are no decision variables included that rate making changes in this current state. Still both stakeholders indicate that their level of trust in the system is not affected and that the optimization results strengthen their perceived usefulness of the improved PAS (De Visser, 2016, pp. 89-92).

8.3.2 The observers' evaluation

De Visser as systems engineer observed the following:

… regarding the effectiveness of PAS. During the first interviews the stakeholders neatly picked first the bottom and top reference alternative and only then established the intermediate value. It was striking however that both interviewees most of the time automatically used the variable value of the EMEA headquarters as this intermediate reference, in order to determine the respective relation with the locations with a higher or lower value. They mostly did this in such a way that it received a preference rating of >50. Because the stakeholders really relate to the values they use in establishing the preference curves, the tool is quite effective.

Another observation is that during the pilot study, people from the [line of business] were not able to dedicate a lot of time to it. This could have been due to the fact that this was a research project without direct gain for the [line of business] representative.

However, also in the original study, the [advanced planning] team had to work under a certain time pressure. This could mean that the tool is only effective when used purely by the real estate department, to generate outcomes and present these to [a line of business] in question. On the other hand however, only the first time use of the PAS with [a line of business] takes some more time, because stakeholders have to get used to the approach. Once this has happened in each global region and a broad set of decision variables, preference curves, weights and design constraints has been established, for each new case only the first four PAS steps have to be completed. Of course also location datasets have to be loaded, which should be updated once in a while. This would make it into a fairly effective tool for all stakeholders involved, in the systems engineer's perspective (De Visser, 2016, p. 91).

8.4 Pilot study comparison and conclusion

In all three pilots, the stakeholders as well as the observers evaluated the PAS very positively. The direct feedback about the effects of the chosen interventions and the possibility for iteration during the process was the other aspect that was repeatedly mentioned in each of the pilots. The group interaction or cooperation between the stakeholders was also very much appreciated in the first two pilots. In the third pilot the group dynamic was different with only two stakeholders which already had a working relation as client and supplier of space. The stakeholders indicated that they valued getting insight into their decision variables and, at the end of the studies, valued expressing their preferences with curves. In the second pilot the use of concrete decision variables was emphasized by many stakeholders. The majority of the stakeholders perceived PAS as attractive and effective. The result (goal) oriented approach contributed to the effectiveness. Almost all stakeholders expressed that they would like to continue working with PAS.

The stakeholders did not always use the same expressions in the evaluation of PAS. For instance, whereas in the first pilot the stakeholders explicitly mentioned the transparency that PAS gave, in the evaluation of the other pilots the stakeholders mentioned this implicitly. In the second pilot they indicated they liked the fact they could have insight in each other's decision variables as well as the effects, which created the transparency. While in the third pilot, the stakeholders indicated that the model performed as expected, the outcome was justified and the model complexity reflected reality, which in the pilot comparison was combined into transparency of PAS.

Most stakeholders were open-minded towards PAS from the beginning. Some of them had a more cautious stand. With all of these stakeholders we have seen that after the pilot they were (a lot more) more positive. Only one of them still questioned whether the approach (sometimes) would not be too transparent. Many stakeholders compared PAS spontaneously to other approaches and in all cases they favor PAS. The first two studies were not set up to compare PAS systematically to other approaches. However, the third pilot explicitly compared PAS favorably to their own internal process.

In the evaluations, the stakeholders also indicated improvements that could be made. The abovementioned positive aspects of PAS as well as areas of improvement have been visualized in **Figure 8.1**.

PAS in general

For these aspects, the observers formulated one recommendation: to introduce the nature of PAS at the start of the process to the stakeholders to prevent misunderstandings about the objectivity or rationality of the approach. In essence, PAS can be labelled as a rational subjective approach.

Formulating demand (step 1 to 4)

Some stakeholders mentioned to that even more and different stakeholders could be used during the pilot study as well as variables and real estate data. Giving a simple example of assigning preferences, as has been done in the third pilot could help stakeholders at the start of the process.

Designing alternatives (step 5)

For the aspects, three recommendations were formulated. In the second pilot, the first workshop has been performed individually instead of as a group workshop. Although this helped the stakeholders understand the model and their decision variables better, the interaction of a second group workshop was missed by some. Therefore, the first recommendation is to use a combination of one individual and two group workshop for PAS and if necessary provide some stakeholders more time for the PAS process. In the consecutive pilot studies, the stakeholders have become more satisfied with the design interface(s), being most satisfied in the third pilot. The representatives of their team were specifically enthusiastic about the visual feedback and ease of use of the design interface. However, many stakeholders indicated that the interface could be improved to understand the effects of the interventions. The second recommendation is both to use less interfaces and less content per interface

and the third recommendation is to give the stakeholders the option to operate the model themselves in between the workshops, to help (some of) them to understand the backend of the model (even) better.

Choosing an optimal alternative (step 6)

For these aspects, two recommendations were made that have already been implemented successfully in the third pilot. Firstly, the use of the optimization tool (step 5b) is regarded as useful addition to the design process (step 5a). Therefore, the first recommendation is to use both ways to generate alternative real estate portfolio. Secondly, in the first two pilots, some stakeholders wanted a check on the results, because they either were not able to involve their 'constituents' or indicated that they wanted to (double) check certain aspects. In the third pilot, the stakeholders did not formulate any reservation, probably because the stakeholders repeated an existing process. This means that is stakeholders are more familiar with the pilot's subject, PAS suffices. The second recommendation therefore is to ensure sufficient time and involvement of stakeholder groups.

Summarizing, in all three pilots the stakeholders as well as the observers evaluated PAS very positively. The direct feedback about the effects of the chosen interventions and the possibility for iteration during the process was the other aspect that was repeatedly most. PAS has been tested and evaluated in three different context in two different organizations; this yields more valuable results than just applying it to one pilot. In a new pilot, it is recommended to experiment with a stakeholder operated PAS model.

From the perspective of the subject owner the evaluation showed that one of them is reserved about the desired level of transparency while the other fully supports this way of working because PAS links concrete interventions to strategic objectives. It is recommended to further study the attitude of policy makers towards a transparent approach. Next to that, it is recommended to perform a PAS process and focus only on evaluating PAS. This evaluation should be approached from both a soft and hard systems perspective from the start. Next to that, a comparative research set-up with other approaches as has been done in the third pilot could be useful.[74]

74 The improvements that stakeholders mentioned and later revoked are not mentioned in Figure 8.1.

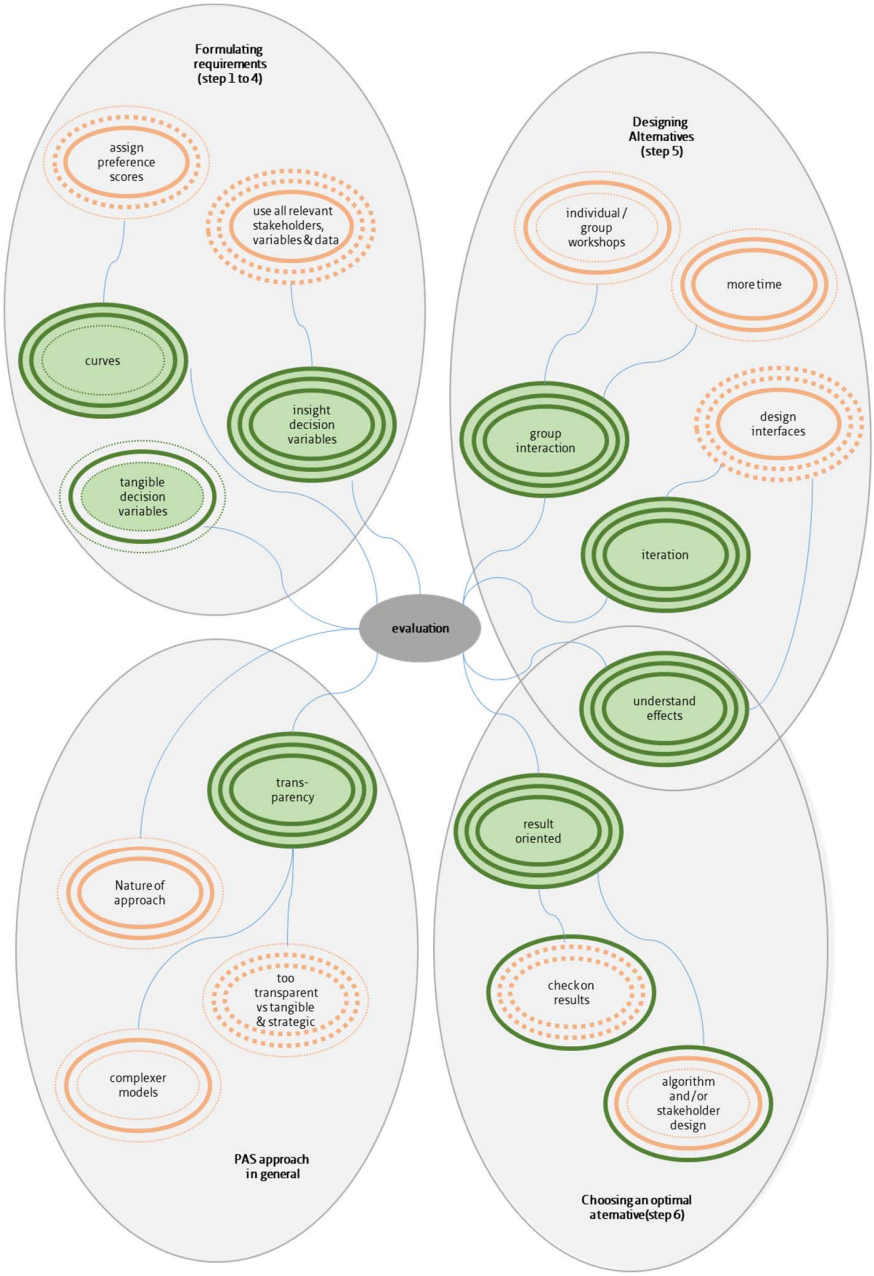

FIG. 8.1 Positive aspects and areas of improvement of PAS visualized. Legend: Each circle line represent a pilots, with the third pilot at the outer edge. A full line means an aspect was mentioned; a dotted line it was not. A green line means an aspect evaluated positively, an orange line indicates a possible improvement. The grey ovals group related aspects.

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